AN

ACCOUNT

OF THE

EXPERIMENTS

MADE IN THE FRENCH NAVY

FOR

THE TRIAL

OF

BOMB CANNON,

ETC.

BY H. J. PAIXHANS,

LIEUT. COLONEL OF ARTILLERY.

"Which" ——————— "with touch of fire
Dilated and infuriate, shall send forth
From far with thundering noise, among our foes
Such implements of mischief, as shall dash
To pieces, and o'erwhelm whatever stands
Adverse, that they shall fear we have disarm'd
The Thunderer of his only dreaded bolt."

PARADISE LOST.

TRANSLATED FROM THE FRENCH,

BY JOHN A. DAHLGREN,

LIEUT. U. S. NAVY.

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THE spirit of change that has wrought so many wonders in our new country is at last extending itself to another and far different field of action; it now bids fair to make and maintain

> "Its march upon the mountain wave,
> Its home upon the deep."

Before its mighty impulse the red man and the forest have receded like the mist of the morning before the rising sun; in their stead have been conjured up rich and growing cities, with all the evidences of wealth and civilization, while the produce of millions of acres contribute to sustain national strength and prosperity; the extremes of our vast territory are no longer separated by distance, but are bound together by innumerable links, along which communication is winged like the electric spark. The spell is now on blue water, and the decree has gone forth against the time-honoured fabrics that have so long "braved the battle and the breeze;" all the graceful pageantry of flowing canvass, and the interminable, but well ordered tracery of rigging must disappear before its influence; even the blast of the gale amid the strained cordage will no longer whistle "soft music" to the ear of the

hardy seaman; snug reefs and leeway will be things of another time, and in their stead, we tighten the screw, oil the machinery and poke the fire.

Among the mighty agents of this change none can compare with steam—as yet in its infancy, numberless difficulties await its career of utility; the enormous mass of fuel consumed, and the heavy outlay of capital, materially lessen its field of action; but reflection and experience will remedy the one, and the increasing employment of steamships reduce the other to the reach of ordinary means. Yet, with all the great present and prospective advantages of the system, opposition of the most stubborn kind is no trifling impediment to immediate success—the experience of nations, the convictions of centuries, the interests of capitalists, and the prejudices of the weather-beaten tar, all unite to turn the inexorable hand of improvement; but it will avail little—the day may even be not far distant when the topsail shall no longer need a reef, nor the to'gallantsail shiver in the squall; the ship will be snugly moored at the dock, and all her glorious panoply lie neglected in the store room, for the moth and the rat to prey upon. In all this the sailor sees nothing but unthinking and unwise experiment; his heart is with the gallant vessel that has borne him on many a

wave, every yarn in that mass of rope is familiar to his eye and his hand; that mere perch far above, is to him as soft and welcome as a bed of down; the recollections of the boy, the hope of youth, and the pride of manhood, are twined around this—his home: far away from the busy hum of improvement he has slept like Van Winkle, awakes, and finds himself stripped of the glory of his profession: With his honest but ignorant sorrow may not the veriest utilitarian sympathize! The names of such seamen as Decatur and Perry are not dear to the sons of ocean alone—they strike a chord in every heart; and while the starred emblem of liberty floats upon the breeze their deeds will be cherished by this nation: it will be remembered that their battle cry was—The freedom of the seas and the rights of seamen; it was their talisman of victory. And the embattled fleets with which Nelson, Jarvis and Duncan have swept the blue wave, how many will sigh to see their glories fade away, and of all their "pride, pomp and circumstance," but a recollection remain! Few, too, will not regret that such creatures as Trunnion and Long Tom are to pass from the scene, and leave as little trace of existence behind as the flying Dutchman or the Mermaid. Marryatt, in anticipation, is already in the far west, but Cooper

still lingers about his favourite theme as if unwilling to leave it.

The haughty three-decker then is doomed, after all, like the steel-clad knight, or the mammoth, to be but the wonder and the riddle of another age.

Among the innovations of the day, is the use of shells instead of shot. The following pages contain some account of the trials made of them in France, and the attention of the honourable secretary, and officers of the navy is respectfully solicited thereto. It is not presumed that the subject is at all new to them, for in an estimate of the Navy Commissioners laid before Congress in 1836, the *bomb cannon* is made mention of; the difference, however, between possessing means and being able to make the best use of them, is very great; attention and practice are the only means by which the latter can be insured. This consideration has been so important with the French government, as to cause the abandonment of all attempt to reap the first fruits of a war by keeping secret the success of the experiment. It will be seen that in answer to a question on the subject by the French Minister of Marine, (page 42,) Mr. Paixhans insists that the only means of ensuring success, is "to be prepared to act promptly at the first sign of war," and that it is absolutely indispensable to be well trained to

the use of *bomb cannon.* The proficiency which our navy has an opportunity of attaining in the use of this weapon can hardly be very great: Few seem to have ever heard of its use in a United States vessel; nor have I observed any mention of this kind of artillery by an American, excepting in the Commissioners' estimate above mentioned, where the term merely occurs, and a short statement of the French experiments in a former number of the Chronicle, which, unfortunately, appears to have attracted very little, if any, comment.

The French Admiral, Count d'Estaing, left Toulon with 12 ships of the line, the 13th of April, 1778, and arrived in the Delaware on the 5th of July, after a passage of *only* 83 days, a most unreasonable loss of time even in those days, and a most unfortunate occurrence for the United States. Had he arrived sooner, the English fleet in the Delaware, and perhaps the land forces in Philadelphia, must have fallen a sacrifice. A dozen such vessels as the Great Western, or Gorgon, would not be quite so long in performing the passage; and it is well known that the English have some 30 steamers, and the French even more; several of them propelled by 220 horse power. The Gorgon also mounts some *bomb cannon* of heavy calibre.

The practicability of using *bomb cannon*

seems to be well sustained by the trials reported in the following statements. Colonel Paixhans, himself, is an officer of rank in an artillery service well known here and in Europe. His larger work proves him incontestably to be a master of his subject; and supported as he is by the intrinsic strength of the evidence presented both in principle and practice, by the opinions of such men as Marmont, Duke de Ragusa, one of Napoleon's veteran marshals, La Place, the celebrated mathematician, Count Valée, who carried Constantine by assault, and by that of many other distinguished officers of rank from the artillery, navy and engineers, the project brought forward by him may reasonably claim the consideration of our naval officers. Some distinction, however, should be made between the weapon itself and the best method of applying it to naval purposes; as a French artillery officer could hardly expect to be conversant with all the technicalities and anomalies of salt water craft—but in the part immediately relating to his own vocation, it will be seen, especially in his larger work, that he needs no apologist.

The present translation is necessarily very different from what was designed. In connexion with that of the large work of Colonel Paixhans, it was made some time since, under peculiar circumstances, with the intention that it should

undergo close revision, and some change of idiom. Increased disease of the eye, however, incurred while in charge of a party of triangulation in the coast survey under Mr. Hassler, has compelled me to forego the design of publishing, at present, the large work of Paixhans, or of making any correction in the pamphlet now submitted; requesting, therefore, such indulgence as circumstances may seem to justify, it is respectfully commended to the officers of the navy,

By their obedient servant,

JNO. A. DAHLGREN.

EXPERIMENTS

MADE IN THE FRENCH NAVY,

ON A

New kind of Artillery, &c.

In a work published in 1822, I entered upon an examination of the actual resources of a naval force, and proposed therein several changes: A new kind of artillery, steamers, vessels rendered shot proof, &c. (See Note 1.)

Of these, the artillery alone has been the subject of experiment. This has been repeated, and in both instances was successful. In the following pages is presented some account of the trials.

The heaviest shot thrown from our cannon weigh $38\frac{3}{4}$ pounds,* but their effects on a vessel are easily repaired. Mortars project bombs equal

* The common English lineal measure and avoirdupois weight are used throughout. The denomination of the French calibres is in round numbers, but in giving them an English value the fraction unavoidably occurs.

in size to shot of 86 or 162 pounds, which explode with terrible effect; but falling in a vertical direction, they rarely reach the mark. My proposition is, to use guns which shall drive the heaviest bombs horizontally, like a cannon shot, and with equal force and accuracy. The explosion of the bomb would make a large breach in the hull of a ship, if it take place there, or cause great mischief within. (Note 2.)

The idea is by no means new, since both hollow shot and shells have been used; but these projectiles, even till now, have been as deficient in precision and range as they have been excessive in size; and many experienced individuals look upon the horizontal firing of large bombs as impracticable.

Nevertheless, it was determined to examine my scheme in detail, and the commission charged with this scrutiny having made a favourable report, two bomb cannon of the calibre $86\frac{1}{4}$, were cast and transported to Brest. (Note 3.)

The strength and range of the new piece were first proven, the latter having been considered as rather doubtful: It was very great, however, and in the first trial, not only were hollow shot of $59\frac{1}{4}$ pounds sent as far as the balls of the heaviest cannon, but even the feeble charge of $10\frac{3}{4}$ pounds carried a massive shot of $86\frac{1}{4}$ pounds to the

distance of nearly 4100 yards,—by no means a common occurrence.

Subsequently, in order to form some opinion of the power of bombs fired thus, the piece was floated on a pontoon bearing upon a ship of the line, and at the distance of 640 yards. Every proper precaution having been taken, twelve shot were fired from the bomb cannon into the vessel, and of these, not one failed the mark.

The effect produced was decisive: the first bomb having shattered to atoms about 160 square feet of wood-work, and diffused an intolerable smoke; another splintered a large part of the main-mast, and at the same time knocked off an iron band weighing 140 pounds; a third carried away a knee of two hundred weight, and overturned some 40 figures by the force of its explosion; another produced an irreparable breach in the side of the ship, &c. (Note 4.)

Yet these were but the effect of a bomb gun of $86\frac{1}{4}$, what then must be that of the 162?

After the trial, the commission composed of the naval commandants at Brest, forwarded a report to the minister, wherein it is said, "*that the weapon proposed is capable of producing a prodigious effect, and will introduce great changes in naval affairs;*" then follows a discussion of the advantages, inconveniences, danger, &c., concluding with, "*The problem is*

resolved,—and without presenting greater difficulties than the ordinary gun, it is evident that this kind of artillery is most destructive. It will be of incalculable utility in coast batteries, gun boats, floating batteries, steamers, &c., and should be used even in our ships of the line, but in a small number, and with great precaution." (Note 5.)

The results obtained having been communicated to the Academy of Sciences, a report was made thereon, in which the proposed improvement was fully approved of. (Note 6.)

To ascertain what farther evidence should be required, the consulting committee of the navy, with the addition of many members, for the occasion, was directed to investigate the matter, to answer the questions addressed by the Minister, and report on the subsequent measures to be taken.

These were in accordance with prudence and the welfare of the service;—it was determined that the experiment should be repeated on a much larger scale; placing the new artillery at different distances, and comparing its fire with that of a certain number of the best guns in service.

In the latter hollow shot were also to be used, and for the common gun itself, was adopted one

of the improvements suggested for the bomb cannon. (Notes 7, 11, and 15.)

The second trial resulted similarly to the first; not only was the effect of bombs of 86¼ beyond all comparison with that of ordinary shot, but it exceeded that of the hollow missiles, far beyond expectation. (Note 8.)

The official statement says: *The commission is fully convinced of the prodigious havoc occasioned by bombs. It is evident that a ship can easily be fired by such bombs. . . . Their power is so terrible that one or two of this kind bursting in a battery, would probably render a vessel untenable . . . They cause such damage in the frame, that a vessel would be in danger of foundering, if struck at the waterline,* &c. (Note 9.)

It may be asked, perhaps, how, under such circumstances, the vessel used as a target was not destroyed? Because every precaution had been taken;—fire engines, casks, cables and men at hand, &c.,—and the shots fired in slow succession. The commissions at Brest have themselves answered the question. (Note 10.)

And besides, when, instead of firing at a damp deserted hulk, where a bomb can operate on nothing, a real engagement takes place with a ship, rigged and manned,—powder passed to and fro in all directions,—the risk of total conflagration

will be imminent, and the consequences may be readily imagined.

With respect to the range of the bomb cannon, (notwithstanding the great weight of projectile,) its precision, strength, recoil, &c., curious results have been obtained, elucidating many principles of gunnery, and correcting several errors; these, if properly applied cannot fail to be useful in theory as well as in practice. (Notes, 11, 12, 13, 14 and 15.)

Still much objection has been made; and since this is even encountered in affairs of long standing, it may reasonably be expected when innovation is proposed. Far from entertaining any wish to avoid it, I would rather, on the contrary, produce it myself:—and a discussion relating thereto will be found in the Note 14, &c.

Notwithstanding every objection, however, the Navy, after a full scrutiny, has undoubtedly been convinced that practice will remove some of the difficulties; others can be remedied at once; and that hence the new artillery should be used in the service; for the official statement concludes as follows: *The commission unanimously admits, that these guns are capable of prodigious effect in coast batteries: no ship of any force could sustain such a fire at* 640 *or* 1300 *yards: it will also be advisable to mount the new artillery on floating batteries, launches, gun boats*

or steamers; *and it is believed that the bomb cannon is well adapted to the defence of roads and coasts, the attack of ships in a calm or on a lee shore*, &c. (Note 9.)

This conclusion confirms that deduced from the first trial, and is even more satisfactory, since the experiment made was on a more extended scale; and moreover, in arriving at a definitive decision it is expected that well conducted scrutiny would pass by no objection that could militate seriously against the change proposed.

The use of bomb cannon in vessels of a large class, is the question to which the greatest opposition should be offered,—since the employment of a large number of loaded projectiles at one time, is said to be dangerous amongst a numerous crew. And yet on this important point, the Navy, perceiving that a few simple precautions only are required for these projectiles, as for powder, is content with recommending proper circumspection. In the report of January it is stated: *by a vote of* 13 *to* 3, *that these guns should be introduced into our ships of the line, but in a small number.* And in the report of October the commission say their opinion was *almost unanimous, that two or four of these guns should be placed on the lower battery.* (Notes 5 and 9.)

But without availing myself of these state-

ments, or referring to the means of obviating all danger, let it be admitted that the introduction of these bomb cannon into heavy ships would be really imprudent, and that they should only be mounted on the smaller vessels, where they can be used with advantage; what then? Why, the ships of the line not daring to use this artillery, will be exposed to its full effect, and one may see a vessel with a small crew, and constructed at a small expense, chasing a heavy ship manned by 800 men. It may be said, that the latter will be able, by its mass alone, to run down a smaller vessel; but to do so, she must first reach her enemy, and before that, may be struck by how many bombs? Moreover, a large ship of the line may be brought to action by a swift and heavy frigate, sufficiently quick to avoid the shock of her huge adversary, and sufficiently powerful with these bomb guns to deal mortal blows.

The question, then, is not merely if this artillery can be employed in ships of the line, but whether it may not even occasion the disuse of this class of vessel. For the bomb cannon was not intended for their exclusive convenience, but for their destruction, and this it is fully competent to effect. Would it be advisable, then, to continue the construction of these huge and costly fabrics, so difficult to manage well, and

requiring so many picked men, when the smallest craft, with a single bomb cannon will be able to sink or burn them?

Some persons may imagine that such weapons are too horrible, and should be rejected—the sentiment is certainly deserving of our respect, but if strictly correct, why use arms at all? What are they made for? Is it not admitted on all hands, that military resources, in becoming more destructive, have not rendered war more murderous? (Note 16.)

If, then, this kind of weapon is practicable, and so effective, it may be asserted that it would have been but proper to keep it secret, to obtain the first benefits from its use in the event of war; certainly, but several trials were indispensable to the success of the scheme itself; and it was necessary to initiate some 200 individuals in the preparation and execution of the experiment; moreover, public and undoubted testimony, sufficient to produce conviction, was required to remove all objection. The government, without doubt, had all these considerations in view, when the permission was given to publish. But farther, even if it had been possible to introduce a new weapon secretly, it should still have been made public: because even if adopted by foreign nations, it must occasion such changes in the general system of maritime warfare as must be

most favourable to France. This suggests several important reflections.

First, should not ships of the line, on account of their size, cost, and number of men, as well as the great proportion which a single one bears to a squadron, be made to give place to structures less huge? and would it be advisable in encountering a weapon so powerful, to risk 800 men and three millions in one ship rather than in two or three? If so, then vessels of less size being built in a shorter time, will be less expensive, as it will not be necessary to construct them very long beforehand; they will no longer require such choice selection of wood—be more easy of management, and find shelter in a greater number with ports. In those respects, therefore, they will be more convenient for France than the present ships of the line, which is not the case with England, because it is richer than France, and its people being more habituated to the sea, and having greater interests thereon, will always have a certain superiority in experience. (Note 17.)

Since bomb cannon, then, are so productive of damage and fire in the common shipping, another result will be, the adoption of iron vessels or of some proof against artillery. It would be difficult, without doubt, to resist the shot of a 39, and much more that of a new gun which drives

the shot of 86¾ with such force. Still the thing is possible, and upon consideration of the question, important in so many respects, there is ground for believing it can be done. It is true that such costly structures appear at first to be more convenient for England than France. But there is another view of the proposition, making it incomparably better for ourselves; for in these iron fortresses combats can no longer be decided by the fire of artillery, nor by any manœuvring, be it more or less skilful; they must be determined by boarding, hand to hand; whence it follows that the power of our fleets will be increased to that of the army; an immense difference!

On the other hand, the introduction of steam is attended with such changes, that it is impossible to pass it by in speaking of improvements in the means of destruction. I also recommended it, and the commission which examined my work in 1819, strongly advised a trial *of steamers in connexion with the bomb cannon.*

These war steamers must be of unquestionable advantage to our navy, being navigated entirely independent of the wind, and entering into combat without the risk of losing a mast, the fall of which would produce irreparable mischief and confusion. Showing little sail, they are only visible at a short distance; and requiring no longer a heavy draft to counterpoise the lofty

masting, they can move anywhere in little water, be protected by the batteries of the coast, and have the use of 60 ports instead of five. Lastly, and the consideration is conclusive, steamers require but few seamen, while the intricate rigging of the present vessels is only manageable with a large number; and the necessity of heavy vessels is less embarrassing to France in contending with England than that of being compelled to seek in her less maritime population a sufficient number of experienced sailors.

In summing up the preceding it is believed that the following is clearly admissible: The English (I always refer to them, because in peace or war they are our most formidable rivals,) may use, like ourselves, bomb cannon; but this new kind of artillery is to produce an entire change in navies, and we have but 160 vessels to lose—England has nearly 500.

They may also render their shipping shot-proof; but when this is the case with both parties, sea fights must be decided sword in hand; in such contest the French arms must easily triumph, be it with whom it may.

The English may have excellent steamers, perhaps better than ourselves. But as this change will render nautical experience and habits

less necessary, must it not result to the advantage of France rather than of England?

Lastly, the English will always enjoy the superiority of number over us at sea, whatever improvement be adopted, having undoubtedly the greater number of good seamen, from their being a maritime people; but we have the advantage equally in good troops, and in the naval force proposed, these must have a predominating influence.

What then is to be done towards bringing the new system into efficient operation? Take the new road opened to us, and follow it with persevering determination; hoard up the results of experience, and adopt such as are likely to prove useful; if difficulties intervene, look upon them as obstacles which can be conquered, not as reasons for abandoning the plan: Such as may occur will certainly never be equal to those encountered in our present admirable structures. And it is not to be feared that blind opposition will be sustained by individuals against a system, where our seamen will find fewer advantages in combat, our artillerists a more destructive weapon; our engineers an extensive field for improvements to be made, and the public service innumerable benefits.

It is not part of my present plan to enter into the different modes of applying the bomb cannon to use; but as many of these may possess interest for different officers, such as the defence of coasts and harbours, the attack and defence of fortified places, I have touched briefly on the subject in the Notes.

Of severe criticism and censure I need hardly say any thing; being the invariable penalty which every innovation is made to bear.

But I may say, and I do it with sincere pleasure, that I have on all occasions met with just and enlightened judges—with protection from authority, and from those men, whose support, always yielded to works of utility, is the most honourable return that can be sought.

NOTES

REFERRED TO IN THE PRECEDING PAGES,

With an examination of some questions relating to the new system of Artillery, &c.

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1. *Synopsis of the propositions contained in a work styled "New Maritime Force, &c."*

This work, commenced in 1809, and submitted in 1819, was afterwards published in 1822. In the first book is given an account of the ordinary resources of a navy: in ships, guns, projectiles, carriages, &c., and concludes with affirming that explosive shot constitute the most important improvement that can be made.

The second book treats of fire-ships, steamers, torpedoes, fulminating powder, &c.; with the conclusion that steamers alone are worthy of serious consideration. The third book demonstrates that instead of having guns of three different calibres in the same vessel, *it is practicable to employ the calibre of the lower battery*

throughout, be it what it may; and this principle seems now to be clearly established. The fourth book advocates the horizontal firing of bombs, and gives in order, the experience obtained at different times in the matter, and opinions thence formed by various individuals. The fifth book treats of the calibres, weight, dimensions, &c., of the bomb cannon. The sixth replies to some objections. In the seventh an armament of howitzer cannon of $51\frac{3}{4}$, in addition to bomb cannon, is proposed for the present shipping. I have been convinced, however, of the impolicy of this plan, since the bomb cannon, being more than sufficient, and a small number of them productive of a decisive effect, it would be useless to connect them with means of less power, thereby increasing the probabilities of confusion. Lastly, in the eighth book it is endeavoured to ascertain by what arrangement of naval *matériel*, vessels of a heavy class can be replaced in our navy, and those of another nation most advantageously encountered, by using bomb cannon in sailing vessels, steamers, and in shipping made shot-proof. The details relating to the size, model and management of vessels for the new system are also discussed.

The appendix afterwards treats of some questions connected with the projection of shells

generally; howitzers for the field and other service; the use of bomb cannon in attacking and defending fortified places; defence of the coast; and lastly, the scheme of vertical firing, advocated by Carnot in 1810, is reviewed, and a comparison instituted between it and that proposed by myself, which was examined in 1809, &c.

2. *On the new kind of Gun submitted for experiment.*

The work referred to in the preceding note, gives at length the dimensions of bomb cannon of various calibres, with the reasons therefor. The new artillery is analogous to cannon in external form and in horizontal fire; at the same time it resembles the mortar within, as well as by the use of heavy bombs; it is still more like the howitzer, excepting, however, that the very best of the latter are short, and cannot be charged heavily without destroying the carriage, therefore differing widely from a piece, which, with the weight of a 39 is sufficiently long to clear the port, is easy in its recoil, and capable of driving a massive shot of $86\frac{1}{4}$ pounds to the distance of 4000 yards, with no greater elevation than 17 degrees. At an angle of 5 to 6 degrees the French $8\frac{1}{2}$ howitzer now used, only ranges

426 yards, while the bomb cannon of the same calibre, and fired at the same elevation, carries to the distance of 2100 yards; (see the Note on ranges.) How much greater, then, must be the power of the calibre 162, ($10\frac{2}{3}$ inches in diameter,) the bombs of which it is supposed could not be thrown horizontally with any degree of force.

For the new artillery I have adopted the term *bomb cannon*, from an old author, as most appropriate: some other might have been found, but what signifies a name?

3. *Report made the 28th of May, 1821, by the Commission appointed to examine the propositions submitted.*

This document first enters into a detail of the question, and then states, that "The commission, after investigating the method of execution proposed, and discussing the different objections made by several members, is of the opinion that the scheme of Mr. Paixhans deserves consideration, for it is evident that howitzer, and especially bomb cannon would be powerful weapons against ships. The commission, therefore, recommends that a trial be made, after the dimensions, weight, model, &c. laid before them." . . . . It is then recommended that "the bomb cannon have

a trial in steamers, and that other experiments there suggested be made," &c.

"*Signed,* Marshal the Duke de RAGUSA.
"Lieut. Gen. Marquis DESSOLES.
"Marquis de LA PLACE.
"Vice Admiral Count de ROSILY.
"Lieut. Gen. of Art. Count VALEE.
"Gen. of Art. Baron EVAIN.
"Gen. of Art. TIRION, Inspec. Gen. of Sea Artillery.
"ROLAND, Inspec. Gen. of Naval Construction."

4. *Effects of Bomb Cannon of* 86¼ *on a Ship of the Line, being the first experiment made at Brest, January,* 1824.

The Pacificateur, a ship of 80 guns, then moored in the roadstead, served as a target. For the security of the vessel, fire engines, buckets of water, empty casks and cables were distributed in her, and around in boats with men, so that she could not easily be burnt nor sunk. The bomb cannon was floated on a small pontoon, about 640 yards from the ship. The first shot sufficed to determine opinion, but to complete the evidence, twelve shot were fired successively. The following is a summary of the results detailed in the official statement of the experiment.

The first shot struck low, and as soon as the explosion was heard, the commission repaired on board. A thick smoke filled between the decks where the bomb had burst—The fire engine was worked, and the smoke lasted 10 or 12 minutes: the bomb had made a breach of 8½ inches diameter in the ship's side, which there was 29 inches thick; it had torn off 2 feet of the inner plank, and then exploding, made a hole in the orlop deck of 2 to 3 feet square, knocked away and shattered to atoms more than 160 square feet of timber.

The second bomb traversed the quarter deck, carrying with it two pieces of plank, one of which was 5¼ feet long,—then striking the mainmast obliquely it knocked off a splinter from 3 to 4 feet long and 9½ inches thick, and bursting, tore away a mast band 10½ feet in circumference, weighing 130 pounds; this mass of iron was driven with such force that one of its halves struck the opposite bulwark, 17 feet distant, where it flattened and adhered. The splinters of the bomb shattered the bitts, cut some of the braces, and would have injured many men and articles of rigging, if the ship had been equipped. The explosion also set fire to a coil of rope. The third bomb entered the side between two ports, struck and tore off an oaken knee 7 feet 5 inches long, and 6½ to 13¾ inches thick, which, with its

iron fastenings, weighed more than 206 pounds, then bursting, its splinters knocked down 40 of the wooden figures nailed around the guns to represent men. The explosion also shattered one of the beams supporting the deck above, starting several planks, one of which was 10½ feet long, and another 5¼ feet, &c.

To abridge this detail, I will only refer to the two most remarkable shots of the remaining nine.

Perceiving that the bombs always passed through the side of the vessel, the charge of the gun was diminished each time: With 4¼ pounds of powder, and always at 640 yards, a bomb struck in the wood between two ports, and burst, tearing away the frame and planking, and making a breach of several feet in height and width, so shattered, that all present thought that the shot would have endangered the vessel, had it taken effect near the water line.

Besides this, two pieces of the iron work weighing 16 pounds, were driven inboard by the force of the explosion, and 19 figures knocked down.

Finally, the twelfth and last bomb, with the same small charge, and at the same distance, struck the corner of a port, knocked away a heavy piece of iron work, and lodged on the other side of the ship against an iron knee 5¼ inches in size, and firmly supported; the blow

made three fissures in the iron, two of which were 4¼ inches thick, and the bomb, still unbroken, buried itself farther in the side, burst, and knocked down 20 figures.

The firing of the bomb cannon of 86¼ was compared with that of an ordinary 39 on the same pontoon; but as the effects of the latter are known, and evidently inferior, only three shot of 39 were fired.

In the next number is given the opinion formed from these experiments.

5. *Report on the first experiments at Brest in January*, 1824, *made by a Commission of Officers of rank from the Navy, Naval Engineers and Artillery.*

After giving a detailed statement of the experiments and the results, the report says that "the weapon proposed is capable of producing a prodigious effect, sufficient to insure victory to the nation which first makes use of it, and that it will introduce great changes in naval forces," &c.

And farther, "The commission having revised the statement given above, and being assured that the effects are noted with precision, arrived at the following opinion after a full discussion:

"Mr. Paixhans proposes 1st. To throw bombs at the same angleas the ordinary gun sends shot;

it is evident that he has resolved the problem, and succeeded completely. 2nd. To produce great havoc within the ships which the bombs strike;—it is also evident that this has been terrible, and so great that it is thought one or two bombs of this kind, bursting in a battery, would make such confusion as to cause the surrender of the vessel, or at least conduce materially to it. 3d. To produce by the power of the bomb and its splinters such damage in the frame, that if the explosion should take place near the water line, the vessel would probably sink; there is no doubt on this point, as may be evidently perceived from the result of bomb No. which, had it struck a few feet lower, would certainly have done irreparable mischief."

Then follows a discussion on the advantages, inconveniences, objections, &c., concluding thus: "After investigating the possibility of using the Paixhans cannon in ships of the line, and deciding in the affirmative, though in a small number, it remained to ascertain what other use could be made of these guns in the navy, and the commission was unanimously of the opinion, 1st. That this kind of arms would be very effective in a coast battery, where proper preparation was previously made; and no ship of any force could withstand such a fire at 640, 850, or even 1070 yards, and must unavoidably give over the attack

on being struck by a few bombs. 2nd. That it would be very useful to mount these guns, either on floating pontoons, gun-boats with sweeps, or steamers, and it is thought, that for the defence of roads and coasts, or for attacking ships in a calm or on a lee shore, the success of the bomb cannon would be infallible."

In concluding the commission declares:

"1st. Unanimously, that the problem proposed by Mr. Paixhans has been resolved in a satisfactory manner; that the weapon which he has brought forward is formidable in its effects, and after a few modifications, will be attended by no greater difficulties in service than the ordinary guns.

"2nd. By a vote of 13 to 3, that these guns should be introduced into ships of the line, but in a small number, and subject to precautions made the subject of a special investigation.

"3d. Unanimously, that the bomb cannon would be of incalculable utility in coast batteries, gun-boats or launches, bombardment, floating batteries, steamers, &c.

"De Gourdon, Vice Admiral and Naval Commandant at Brest.

"De Kerlerec, Major General.

"Geoffroi, Director of Naval Construction.

"D'Herli, Director of the Port.

"Godebert, Director of Artillery.

"LEMARANT, LAHALLE, COURCY and TOUFFET, Captains of a 74.

"SIMON, Sub-director of Construction.

"GERODIAS, Sub-director of Artillery.

"GICQUEL DES TOUCHES, Sub-director of the Port.

"LETTRE, DE ROSSY, CONHITTE and DEMARE, Captains of Frigate Couhitte."

6. *Report made to the Academy of Sciences, and approved by it May* 10*th*, 1824.

This paper, among other details, states that experiment has shown "that the terrible effects of the bomb cannon exceed any idea that had been previously formed" of them; that the shot "had produced such damage on board the vessel that it would have been impossible for her to continue the combat, and might even have caused her instant destruction;" "that the ranges obtained were extraordinary;" "that the astonishing power of the piece by increasing the effect, can be made to modify materially the artillery practice ashore and afloat; that Mr. Paixhans is worthy of all praise in having brought the method to notice, and that he may well congratulate himself in finding his theory sustained by experience"— "That if the gun of 86$\frac{1}{4}$ is capable of such effect,

it will be difficult to conceive that of the 162 proposed by Mr. Paixhans."

Finally, the report to the Academy concludes thus—"The commission is now unanimously of the opinion that great advantages must result from the adoption of this kind of gun, which, in the defence of the coast, in gun-boats, floating batteries, entrances of roads, &c., would entirely frustrate every attempt of a hostile squadron of any force whatever. The commission is equally satisfied, that by farther experiments on the use of this weapon in ships, some change may be made in the artillery itself, or in the construction of the vessel, which will render the use of the gun practicable therein, and without danger. The evident consequence of this will be to establish a kind of equality between vessels of different force and class, a result entirely in favour of the nation which has the fewest large vessels and most population, therefore more advantageous to France than to England.

"Baron SANE, late Inspector General of Naval Architecture.

"DE ROSSEL, Rear Admiral.

"DE PRONI.

"Marquis DE LA PLACE.

"Marshal the Duke de RAGUSA, (reporter.)

"Baron FOURIER, Perpetual Secretary of the Academy for the Mathematical Sciences."

7. *Opinion of the Consulting Committee for the Navy; new trials directed on a larger scale than the foregoing.*

His excellency the Minister of Marine, having proposed eight questions respecting the experiments above given, they were discussed by the consulting committee for the navy, with the addition of many members for the occasion. The result of the discussion was a recommendation of farther trial and on a more extensive scale.

It was then directed, instead of comparing the fire of a single bomb gun with that of an ordinary gun at the single distance of 640 yards; that two bomb guns should be used with a long 39, a long 26, and carronades of the same calibre placed in succession at 850, 1070 and 1280 yards from the ship. That solid and hollow shot should be fired from each of the six pieces. That in this experiment the shot of 25 and 39 should be so increased as to make a windage equal to that used for the bomb cannon; and lastly, for greater accuracy, that special trial of the different ranges should be made ashore.

The following are the questions proposed by the minister, presenting all the points for discussion. Subjoined are the brief answers which I

had the honour to present to the consulting committee; advising, as well as the committee, only a gradual adoption, and that sustained by full experiment.

1st. *Are the experiments made at Brest sufficient to determine the entire effect that can be produced on vessels of war by bombs?*

The bomb cannon has proved successful; its range and accuracy considerable, its use easy, the destructive power very great, and a favourable report has been made by the naval officers of rank assembled at Brest: It would therefore be proper not to adopt this weapon immediately, but to select a certain number of the guns for the purpose of subsequent trial, in order to investigate thoroughly before a definitive decision.

2nd. *If so, what will be the best application of these guns on board of vessels, coast batteries, floating batteries, or steamers?*

Opinion can be better formed after a series of experiments in two or three ports; 1st. in a ship; 2nd. behind the works of a coast battery; 3d. on board a gun-boat, or other craft of that kind; to which there should be added some bomb cannon for the experiments ashore to determine the range, as well as their utility in the attack and defence of places.

3d. *Would it be expedient to cast immediately a certain number, for trial at sea?*

Such number as will be required to execute that proposed in the foregoing article.

4th. *Should the trial be made in the king's ships, what precautions should be adopted to prevent any danger from working the bomb cannon and handling the projectiles?*

If it be proposed to use hollow shot in the hundred pieces of one vessel, the precautions would be endless, and danger difficult to be avoided. But at present it is only intended to employ four or six bomb cannon in the lower battery, where the projectiles will be carried but a short distance, and being very powerful only but a small supply will be required. Now it would be much less dangerous to use 400 or 500 pounds of powder enclosed in globes of iron, than 60,000 pounds in slight barrels of wood, as is now practised without inconvenience. Like precautions are used with the bombs as with powder, with the bombs in ketches or grenades. The preservation of the bombs from damp, will not be found more difficult than in the case of the howitzer shells which are exposed to the rain in wagons not very tight, and thus carried about for whole years.

5th. *If the experiments made be not sufficient, what farther trials are required to complete them, at what place, with what number of guns, and at what kind of mark?*

The detailed plan before spoken of would be fully arrranged during the fabrication of the guns, carriages and projectiles.

6th. *What improvements would these guns and their carriages appear to be susceptible of, from the first trials?*

The changes to be made therein will be inconsiderable. The piece used on the occasion was intended to have the weight of the old 39, (8,095 pounds); it proved to be 8,131, but will be reduced to the weight of the present 39, 7,771 pounds. The preponderance of the gun not being sufficient will be increased, and a small eye at the chase added for the convenience of housing. As to the projectile, that used seemed to require no change. The carriage was somewhat incorrect in dimensions, it will in future be made like the ordinary carriage.

7th. *What expectations can be entertained from the use of these cannon in the royal navy, with any probability of being realized?*

The horizontal projection of bombs must make great ravages in a vessel, and may, by a single shot, endanger her safety. Now, with such weapons, a fleet composed of smaller and fewer vessels, will have an evident advantage over another fleet, when every thing is crowded on board a small number of heavy ships. It is therefore probable that in future either vessels of

war will be reduced in size, or some means will be found of rendering them shot-proof. If the former, then smaller vessels will require less time for construction, be less difficult to manœuvre, and can be hazarded more conveniently, as their loss will be less serious: They could also, by keeping inshore, easily find protection in case of necessity: Such a navy would certainly be better adapted to the resources of France than one of heavier ships.

The project of rendering vessels shot-proof, I believe feasible; in 1809 I made a trial of the kind, and proposed that iron armour be used jointly with bomb guns. But in the experiments at Brest, the new gun exhibited such range and power of driving the shot and shells of 86¼ that plates of enormous thickness would have been required to resist them. The solution of this question, however, will also prove advantageous to France, for then sea-fights can only be decided sword in hand, in which event our fleets can be strengthened from the land forces. So that bomb cannon, whether by the reducing the size of shipping, or bringing armour into use, must be of great utility.

8th. *Finally, by what means, and to what extent can the French navy exclusively profit by the use of bomb cannon, at least for a time?*

By being prepared to act energetically and at the first sign of war. And as the circumstance of *first discovery* is in itself of no moment, unless followed up by judicious and steady practice, it is absolutely indispensable to be well trained to the use of bomb cannon.

Paris, June 17, 1824.

8. *Repetition of experiments on a Ship of the Line, with Bombs of* 86¼, *and with Hollow Shot of* 39 *and* 26, *at Brest, the* 27*th*, 28*th and* 29*th of September*, 1824.

Of the six bombs fired at 850 yards, the first after passing through two ports exploded beyond the ship: the second struck without bursting: the third did great damage: the sixth shattered the upper sill of a port: and the official paper says of the fourth, "that after penetrating the side 3 feet above the water, the explosion knocked out the butt of a plank, making a breach of nearly 3 feet square." Moreover, that two streaks of planking below this aperture, and one above, 22 feet long, were started and separated from the frame more than 5¼ inches at the place of explosion, and 2 inches at the scarfing. And that a like breach at the water line would have caused the ship to founder immediately. Finally, of the fifth bomb, the report, after detailing con-

siderable damage, adds: "that flame manifested itself, so as to endanger the vessel, had not prompt measures been resorted to."

Of fourteen bombs fired at 1070 and 1280 yards, nine exploded too soon, or not at all; owing generally to the use of experimental fusees instead of the ordinary ones. (See Note No. 13.) As to those bombs in which the fusees had their usual action, the effect was always more or less remarkable. The official statement says of one that was thrown at 1280 yards: "that it penetrated the side, and there burst, shattering two ribs of the ship, the spirketting two outer and two inner planks, and left a large aperture of more than two square feet. The nearest knee was also broken in three pieces, one of which was projected to the middle of the vessel."

The same paper also says of a bomb thrown at 1070 yards, that "After striking the water it lodged in the dead work between two ports of the lower battery. Its explosion knocked out an entire plank between the ports, two-thirds of another, raised a third its entire length, and shattered a sound piece of the frame; taking effect also within, it started three innner planks and the iron gun bolts and rings of the nearest port."

In these trials, hollow shot were discharged from the guns and carronades of 39 and 26 conjointly with the bombs of 86¼. The several

effects should have been very near the ratio of the numbers 86¼, 39 and 26, but they were not: and the results of the 39 and 26 shot mentioned in the official statement are so inferior that it was thought unnecessary to quote them here. This difference is owing to many causes, the principal of which I believe to be that the bursting of the projectile becomes proportionally easier as the size of the projectile itself is increased, and consequently the heavy shells, after splitting, have a greater proportion of powder and incendiary matter, to act externally against any object.

There can remain no doubt, therefore, of the comparative power of bombs and hollow shot. And besides, the effect of a quantity of powder, used successively in four hollow shot to produce certain effects, is evidently inferior to the effect of the same quantity in a single bomb, which opens an enormous breach, and perhaps may fire the vessel and ammunition.

It was not thought necessary to make any comparison of the effect of solid shot with that of bombs or hollow shot.

9. *Report on the second experiments made at Brest in September and October*, 1824, *by a Commission of Commandants from the Navy, Naval Engineers and Artillery.*

This report, annexed to the detailed statement

of the experiment, investigates various objections, &c. Having quoted and examined all of these in another place, I shall at present only refer to the following passages:

"It is evident," says the report, "that a ship could be easily fired with such bombs.

"The commision having been on two occasions satisfied of the prodigious damage done on board the Pacificateur by bombs, is of the opinion, after a full discussion, that the Paixhans cannon can throw bombs horizontally, or at the same angle as the common gun. . . . . Their power is so terrible, that should one or two bombs of this kind burst in a battery, the vessel would probably be rendered untenable."

"That the explosion of a bomb in the frame of a ship would be productive of great mischief; and if this occur at the water line the vessel must founder, as may be inferred from the effect of bomb No. 8."

With respect to the introduction of bomb cannon into ships of the line, the commission, considering the danger and confusion that might be occasioned by the use of too large a quantity of loaded shells, "do not think it advisable to mount them on an entire battery of a ship, but is almost unanimously of the opinion, that two or four of these guns should be placed on the lower battery, especially at its extremes, taking care to provide

a special magazine for the reception of the bombs."

Finally, the commission recommends, "that before the adoption of this weapon in ships of the line, trial be made of it at sea, under every variety of circumstance."

And respecting their employment in other ways, such as on the coast, &c., the commission unanimously admits, "that these guns are capable of prodigious effect in coast batteries: as no ship of any force, could possibly withstand such as fire at 640 or 1300 yards: that it will also be advisable to mount the new artillery on floating batteries, launches, gun-boats or steamers; and it is believed that the bomb cannon is well adapted to the defence of roads and coasts, the attack of ships in a calm or on a lee-shore, &c.

"Rear Admiral BERGERET, *President of the Commission.*

"Col. GODEBERT, *Director of Naval Artillery.*

"LASALLE, RUSSEL and BEHIC, *Captains of Ships of the Line.*

"SIMON, *Sub-director of Naval Construction.*

"GERODIAS, *Sub-director of Naval Artillery.*

"LONGUEVILLE and PASQUIER, *Captains of Frigates.*

"Brest, Oct. 26, 1824."

10. *Remarks on the condition of the Ship after the experiments at Brest.*

In the foregoing trials the ship received 25 bombs, which gave full proof of their power, in the damage done; it seems proper, however, to explain why she was not entirely destroyed. The reason, as has been already shown, is very simple;—every possible precaution having been taken to prevent such a result, on account of the value of the vessel. I cared so little, too, for any thing more than a proper knowledge of the principal facts, that I did not even put rock-fire in all the bombs. The 25 shells were fired in the four days of trial in January and September, and the damage done by them was repaired gradually, as they were discharged at considerable intervals of time. With regard to the farther opinion of the commissions at Brest:

That of January says in its report—"The havoc caused by the use of the Paixhans cannon, may well cause them to be dreaded by vessels; and it should be observed that the Pacificateur, not being equipped, contained no combustible materials, such as tarpaulins, sails, tarred rope, &c. It is not surprising, therefore, that flame was not produced, but from the quantity of charred splinters of wood, and the ignition of a

coil of rope, it is unquestionable that a ship could easily be fired with such bombs, if charged with inflammable matter of good quality. It should be remarked, that one great cause of confusion produced by the bursting of these projectiles in a battery, independently of the splinters, would be the thick smoke, which, diffused every where, would be almost insupportable."

And in October the commission says: "The continued havoc made by the bombs discharged from the Paixhans cannon at the Pacificateur, was such as would have caused surprise that fire was only communicated once in a dangerous degree, were it not accounted for by the absence of all the equipments of the vessel, which would be strewed around, especially during a fight, and more or less easily ignited. The vessel was also old, and very damp—it is clear, however, that shipping could easily be fired by such bombs."

11. *Experiments made at Brest in October*, 1834, *on the range of Bomb Cannon of* $86\frac{1}{4}$, *compared with that of the sea gun, and on the ranges of solid shot compared with that of hollow shot.*

In recommending peculiar pieces for the horizontal projection of bombs, I sought to prove that they would possess *a range equal to that*

of the present sea artillery, and even greater; the first trials at Brest in December, 1823, and January, 1824, have proved this to be the case. The result, which is inconsistent with received opinion, was attributed to the reduced *windage* of my gun; and it is true, that to this, in connexion with the increase of calibre it was principally due.

It then became desirable to know to what extent the ordinary gun could be improved by reducing the windage; new trials were therefore instituted, ashore, for greater accuracy, and the ranges of the bomb cannon 86¼ were compared with those of guns and carronades of 39 and 26, using in the latter balls sufficiently large to produce a windage equal to that of the new piece.

As it was wished at the same time to compare the range of hollow shot with that of solid shot, trials were made with both in the calibres 86¼, 39 and 26.

The results are given in the following table, in which I shall only refer to the ranges of the 86¼ and long 39, omitting those of the 26 and carronades; for the long 39 being the heaviest in service will suffice, *a fortiori*, for the comparison in view.

For the 26 and the carronades a summary will answer.

The solid shot of 86¼ calibre weighed from 86½ to 89¼ pounds; the hollow, from 60½ to 62½. The solid shot of 39 having been chosen from the heaviest, weighed from 41 to 42 pounds; and the hollow, from 28 to 29 pounds.	RANGE IN YARDS.			
	Bomb Can. 86¼		Ordin. long 39	
	Solid.	*Hollow.*	*Solid.*	*Hollow.*
	At an elevation of 3 degrees.			
Charge of Powder.	2089	1918½		
	1502¾	1918½		
	2089	1886¼	2110½	1875¾
For the 39, 7,757 pounds.	1502¾	1534¾	1577¼	1715¾
„ 86¼, 10,793 „	1460	1598½	1598½	1522
	2216¾	1939¾		
Mean range, - - - - -	1810	1799½	1762	1704½
	At an elevation of 5 degrees.			
	2110¼	1886¼		
	2110¼	1952½	2282¾	1818¼
Same charge.	2067½	2025	2430	2072
	2451¼	1918½	2540½	1875¾
	1897	1907¾		
	2131½	1897		
Mean range, - - - - -	2128	1931¼	2417½	1922
	At an elevation of 8 degrees.			
	2221	2280¾		
Charge.	2210¼	2434	2280¾	2099½
For the 39, 9,714 pounds.	2218¾	2421½	2349	2423½
„ 86¼, 13,355 „	2483¼	2402	2419½	2513
	2238	2227½		
	2242¼	2397¾		
Mean range, - - - - -	2269	2360½	2349¾	2345½
	At an elevation of 10 degrees.			
	2376½	2621¾		
	2472½	2604¾	2579	2711¼
Same charge.	2366	2589½	2749¾	2493¾
	2423½	2483	2930¾	2312¾
	2615¼	2610		
	2660	2419		
Mean range, - - - - -	2485¾	2554¾	2753¼	2506
	At an elevation of 16 degrees.			
	3223	3442¼		
Charge.	3836¾	3719½	3655½	3389
	3525½	3932¾	3943½	3378½
For the 39, 12,951 pounds.	3529¾	3794	3747½	3229½
„ 86¼, 17,809 „	3922	3329½		
	3612¾	3421		
Mean range, - - - - -	3608	3606½	3782	3332½

Taking the mean ranges given in the preceding table, the general result of the trial will be—

Mean range	At 3 degrees,	1810	1799⅛	1762	1704
	5 ,,	2128	1931¼	2417⅛	1922
	8 ,,	2269	2360⅛	2349¾	2345¼
	10 ,,	2485¾	2554¾	2753¼	2506
	16 ,,	3608	3606½	3782	3332½
Sum of the means, - - -		12300	12252¼	13064¼	11810¼

Previous to making any deductions from the results it should be observed that the charge of powder was proportionally less for the 86¼ than for the 39.*

I do not say that it should have been otherwise; on the contrary, I think that the charges were proper—the observation is necessary, however, to a proper understanding of the results;—whether taken into consideration or not, the following conclusions are deducible:

1st. The ranges of bombs compared with those of the 39 shot (having on this occasion a much smaller windage than ordinary,) were in the

* When the charges were 7¼,—9¼ and 13 pounds for the 39, they were 10¼,—13¼ and 17¾ pounds for the 86¼, whence it follows that in firing shot and shells the approximate proportion between the weights of the charge and projectile would be:

⅕	for the 39 when it was only	⅛ for the 86¼.
¼	"	⅙
⅛	"	⅖ or ¼
½	"	¼

ratio of 12252 to 13064, that is of 100 to 106, which explains why, in the first experiments, with the 39 and the common windage, the range of the new piece was superior to that of the 39. It may be perceived, however, that the bomb cannon has qualities at least equal to those of the heaviest guns in service.

2nd. The bomb cannon of 86¼, although served with charges proportionally less, threw the solid shot of 86¼ pounds nearly as far as the long 39 (improved by reduced windage,) sent its shot, the proportion being 12300 to 13064.

3d. With the long 39;—the hollow shot, (being in weight ,679 that of the solid shot,) ranged nearly equal to it; the ratio being 11810 to 13064.

4th. And lastly, it is well worthy of observation, that with the bomb gun of 86¼, the shell, (in weight, ,707 of the shot,) ranged almost exactly equal to the latter: the proportion being 12252 to 12300.

These different results, obtained from authentic experiment, and made *ad hoc*, accord with those of many other trials.

It should be especially remarked, how little foundation there is for the belief, too generally admitted, of the inferior range of shells, and hence many useful conclusions may be deduced.

If to these data it be desired to add the analo-

gous results given by all the pieces which were tried on this occasion, the following are the sums of their mean ranges taken from the official statement.

Kind of Gun.	*Calibre.*	*Solid Shot.*	*Hollow Shot.*
Carronade,	26	9308¼	9283
Carronade,	39	9866¾	8920½
Long Gun,	26	12541¾	11331¼
Long Gun,	39	13060	11800
Bomb Gun,	86¼	12296½	12252
		57073¼	53586¾

This table shows that the ranges of all the pieces, (but especially of the 86¼,) fired at the different angles which the sea carriage admits of, the difference between solid and hollow shot is far from being as considerable as was thought. The ratio of the two being 57073 to 53587.

The following additional results from the first trials made at Brest in December, 1823, are worthy of notice:

1st. The bomb gun of 86¼ fired with 10,79 pounds of powder, at the small angle of 2½ degrees, projected two bombs at once, weighing [with their *shoes*] about 132¾ pounds, to the distance of 1961 yards.

2nd. The same piece fired with a charge of ⅓ the weight of shot, (19,09 pounds,) at an angle of 37½ degrees, carried its bomb 4455 yards, (2½ miles.)

3d. Finally, the gun with a charge of $\frac{1}{8}$ the weight of shot, (10,79 pounds,) fired at 17 degrees, an angle which the sea carriage admits of, threw a solid shot of 86$\frac{1}{4}$ pounds to the distance 4114 yards, a dynamic result very remarkable.

I have not been scrupulous in lengthening the note by quoting these several facts, because in science they are all-important, being the only means by which farther improvement can be ultimately arrived at.

12. *Observations on the Model of the Bomb Gun tried at Brest;—its strength, facility of management, charge of powder, effect and recoil.*

The model of two bomb guns of 86$\frac{1}{4}$, which were very well cast at Indret after the plan given, will need but few of those changes which are always required after a first attempt: the weight was that of the old long 39—8041 and 8131 pounds, it will be reduced to that of the present guns, 7771 pounds.

The trunnions were found to be some lines too near the breach, causing a depression of the chase at the instant of recoil—they will be removed a little farther forward. This and the additional weight produced a necessity for more force than was required to handle the 39. It

was thought better also to place an eye at the pomilion of the gun for the convenience of housing.

The strength of the gun in proportion to its weight and length, ought to be greater than that of the pieces now used, as the proportion of thickness around the charge to that of the chase is increased. To determine the solidity there was first fired from one of the guns, (December, 1823,) a solid shot of $86\frac{1}{4}$ pounds, with a charge of $10\frac{3}{4}$ pounds, then a bomb of 57 pounds with a charge of $19\frac{1}{2}$ pounds, and finally two bombs at once, weighing $132\frac{3}{4}$ pounds, with a charge of $10\frac{3}{4}$ pounds. Afterwards, there were fired from the other piece, (October, 1824,) three rounds double-shotted, each weighing $172\frac{3}{4}$ pounds, with the heavy charge of $21\frac{1}{2}$ pounds, and three more rounds double-shotted, with the yet heavier charge of 28 pounds. These trials, although uncommonly severe for guns intended to throw hollow shot of 54 to $63\frac{1}{2}$ pounds, with charges of $6\frac{1}{2}$ to $10\frac{3}{4}$ pounds, were nevertheless productive of no injury to the gun, and the bore, on being examined with the proof by water, &c., was found to remain, say the two official statements, "as smooth as the finest mirror." This capability of resistance is chiefly due to the excellent quality of the work executed at Indret—the

reduced windage, the well cast shot, and perhaps to the correctness of the several dimensions.

In working, the bomb gun, as stated above, required two men more than the 39; this inconvenience, however, will be remedied. Otherwise, the common apprentice gunners handled the piece well, without any particular instruction, and the time consumed in firing a shot was 4, 5 or 6 minutes, as with the 39.

It has been insisted on that the shot of 39 pounds is already too heavy to be conveniently entered into a gun, when there is much motion in a vessel, consequently a bomb of the weight intended will be entirely inadmissible:—There are several methods, however, of removing this difficulty;—for instance, a small tackle at the port may be used.

Lastly, as the carriage is constructed on the same principle as that of the common gun, and similarly fitted, there is nothing novel in this respect.

Respecting the charge, that of $8\frac{1}{2}$ to $10\frac{3}{4}$ pounds sufficed for the greatest distances, and that of $4\frac{1}{4}$ to $6\frac{1}{2}$ pounds for short distances. If, then, it were desired to have only one charge of powder throughout, it would be best to use that of about 7 pounds, being nearly $\frac{1}{8}$ the weight of shot. The small charges are often deranged in entering the chamber, but this inconvenience

would no longer exist, when the proper charge had been determined by trial, since the chamber would then receive definitively the dimensions best adapted to the cartridge. Moreover, if it be also desired to have two charges, the bulk of the smaller one could be increased by a plug, so as to fill the chamber.

With a heavy charge it is known that the howitzer ruins its carriage, and with a small charge has neither accuracy, force nor range. But the new gun possesses considerable *inertia*, and can therefore have great power with a moderate reaction: In the first experiments the recoil was easy, with a whole charge, and almost nothing with that of 4 to 6 pounds, which would answer for 640 to 850 yards. This circumstance of small recoil was so well established, that a member of the commission thence conceived the idea of using some bomb cannon in certain cases, without recoil. The piece would then be stationary even during the process of loading, whence it would require fewer men, and be fired quicker than the ordinary gun. During the trial in October, the recoil was often violent, but this, I think attributable to the cartridges used on the occasion being too small in diameter,* thereby

* The chamber of the second bomb gun had, by way of experiment, the calibre of 32¼, whilst that of the first was only 26, which seems preferable.

confirming the observation which I had before made on this matter "that the difference between the diameter of the charge and the piece has been too much neglected. When it is considerable, then is a large quantity of fluid ignited, before the projectile is displaced, and hence the force of the recoil is much increased." It will not be difficult therefore, to render the recoil of the bomb gun as moderate as at the first trial, since it is only necessary to have cartridges which fill the chamber completely.

13. *Remarks on the accuracy of Bombs fired horizontally, their power of penetrating the side of a ship, certainty of explosion, &c.*

The precision of the bomb gun has proved to be very great, for in January, although placed on an unstable pontoon, every shot of the twelve fired at 640 yards, struck the vessel.* Afterwards in October, of six shot fired at 850 yards, every one hit the mark. Of six shot fired at 1060 yards, three reached the ship; and the other three would also have struck, had they not exploded too soon. Finally, of eight shot fired at 1280 yards, four hit the ship, three burst too soon, and one only failed. Thus, although at a

* Two shot were fired first to ascertain the point-blanc range, always undetermined in a new model.

considerable distance, 25 shot out of 32 struck, six exploded before striking, (the fusee burning too rapidly,) and one alone missed entirely.

The force with which the bomb was driven, proved rather too great than otherwise; since at a distance of 640 yards it was necessary to reduce the charge to $6\frac{1}{2}$ and even to $4\frac{1}{4}$ pounds, that is to $\frac{1}{12}$ the weight of projectile, in order to lodge it in the side of the vessel. From Nos. 4 and 8 it is evident that the bomb passed easily through the thickest parts of the side, even where the riders presented enormous masses of timber. It may also be perceived that the projectile after penetrating two or three feet of oak, drove to a considerable distance very heavy fragments of wood and iron. One of the bombs fired with a charge of only $4\frac{1}{4}$ pounds at a distance of 640 yards, after fracturing an iron knee 4 inches thick, had force sufficient to bury itself one foot in the side of the ship where it burst. Nor are the bombs broken even by the violent concussion of striking, as they possess a thickness and concentricity unusual till now.

With regard to the fusee, it will be observed, that during the trial in January at 640 yards, thirteen bombs out of fourteen were exploded by the common fusee. At the trial in October, out of twenty shots fired at 850, 1060, and 1280 yards, ten bombs burst as intended, six too soon

and four not at all. It must be remarked, however, that those which did so badly were either the experimental copper fusees, or short wooden fusees of 39 calibre, which, moreover, were intended for 640 yards, and not for 1280; and it is more than probable that the common fusee for the 8½ inches calibre will always succeed, as its length will always admit of its being adapted to any distance. The short fusees for the 26 pound howitzer burn sufficiently long to be used at 2130 yards; long fusees for the 86¼ may therefore be made to last the same time. It has been remarked, that the explosion generally takes place immediately after the shell strikes: and the English and Americans are said to possess a secret method of effecting this instantaneously: the fact is, however, that the force of the blow, by detaching the contents of the fusee will always produce a like result. The fusee itself may be relied upon about as well at sea as on shore, where they are frequently transported for hundreds of leagues in magazines that are far from being perfectly tight. Some fusees will of course fail at times, but this may be guarded against to a certain degree by preserving them from external accident,—the plan proposed by a naval officer seems well adapted to this purpose,—it consists in having for each fusee a small cap securely screwed on, and only to be removed when the

bomb is in the mouth of the piece: thus preventing the possibility of any danger. It is evident that a projectile which is burst by one pound of powder and can contain $4\frac{1}{2}$, may, in lieu of the surplus powder, receive a large quantity of rock fire or other combustible ingredients, and be rendered fully capable of producing conflagration. In January but few bombs were used with rock-fire; these, however, gave the commission occasion to say: "it cannot be doubted that such bombs will readily set fire to a ship." At the trial in October, "the fire caused by a bomb," says the official statement, "burst into flame, so as to endanger the vessel if prompt means had not been taken to prevent it. Refer also to the Notes 5, 9 and 10. Lastly, the combustible matter from the shells will most probably ignite the powder that is passed along the decks during a fight, producing terrible consequences, and perhaps a conflagration, that nothing can arrest.

14. *Some objections answered.*

The preceding statements are, almost without exception, in favour of the proposed method of throwing shell shot.—Nevertheless, there are some objections made, which must not be passed unnoticed; these occur in the official reports and documents as well as in some remarks made by

myself. In order to avoid a repetition and omission, they may be briefly summed up thus, as referring—

1st. To the form of the new piece, its weight, strength, facility of manœuvre, charge, carriage and recoil.

2nd. The precision of firing, penetration of bomb, certainty of explosion and capability of communicating fire.

3d. The windage of projectile, which is less in the bomb gun than hitherto in the sea cannon.

4th. The danger of employing explosive projectiles in vessels.

In the Nos. 12 and 13, I have just answered the 1st and 2nd objections; and in Nos. 15 and 16, I shall explain away the other two.

The excessively destructive power of the new artillery I do not consider as an argument necessary to notice; and shall restrict myself to the consideration of such exceptions as are legitimate and of sufficient importance.

15. *General remarks on the windage of the Bomb Gun of* $86\frac{1}{4}$, *and on that of the guns intended for Sea service.*

This subject embraces many questions intimately connected with the improvement of

artillery, and therefore requires to be treated in detail.

It is certain that the range of any piece, as well as the precision and *momentum* of its ball are increased in proportion as the space between the projectile and bore is diminished: The trials at Strasbourg, Turin, Volwick, &c., prove that the advantage thus gained is very considerable. But as much inconvenience is caused by exceeding a certain limit, let us investigate what this should be.

Several objections may be urged against reducing the windage too much,—the most important of these is that the introduction of the shot may become difficult from foulness of the bore, or the rust which is apt to form: and perhaps it may be desirable to use hot shot. Let us examine these separately—

1st. It is 39 years since the windage of sea cannon was fixed: at that time iron castings were brittle, the fabric imperfect, the guns and shot inaccurate. But now, both cannon and projectiles are cast with perfect precision, and the principal advantage of this improvement will be lost in neglecting to reduce the windage, upon which the accuracy and range of guns so much depend.

2nd. The foulness of the bore, which diminishes in proportion as the windage is reduced,

will be less in the bomb cannon, which only burns 6 to 8 pounds of powder more than in an ordinary gun, which consumes 13; it must certainly be much less than in the *Willantrois*, which requires 32¼ pounds, with a very small windage; and lastly, the firing is not so rapid in the heavy sea or coast pieces as to foul them very soon.

3d. Rust increases the size of shot, reduces the diameter of the bore, and is certainly formed faster at sea than on shore, excepting along the coast, where the pieces are of iron as well as the ship guns, and the precaution used is less—consequently, the standard windage that is applicable to one is equally so to the other.

4th. As the projectile of the bomb cannon can never be heated, reduced windage cannot be excepted to on that ground; nor for sea pieces generally, as hot shot are altogether disused in shipping; and along the coast are fired with the windage of field guns.

Finally, throughout the experiments which were made in September and October, 1824, at Brest, for comparing the range of bomb cannon with that of 26 and 39 cannon and carronades, the windage of the four pieces was reduced to that of the bomb guns, and no inconvenience resulted therefrom.

Without relying on generalities, or the results of a single trial, however, let the question be

examined and determined numerically. The iron coast guns of 25 and $17\frac{1}{4}$, adopted from the land service, have never found any insuperable inconvenience in the use of a *minimum* windage (1,06 lines,) from the liability to foul, the occasional necessity of hot shot, imperfections of figure, or the rust apt to form about shot, especially when permitted to remain on the sand of the shore. In adopting this windage for the bomb gun, therefore, we should be fully sustained by experience. It may be said, however, that the size of calibre is not the same, and that the $86\frac{1}{4}$ requires greater windage than the 26 or the 17. To this it may be answered, that the $8\frac{1}{2}$ inch mortar and howitzer of the calibre $86\frac{1}{4}$ have this very *minimum* windage of 1,06 lines; and that the 10,6 inch mortar which throws the old inaccurate bomb of 150, has no more— nor the long Willantrois of $8\frac{1}{2}$, $10\frac{3}{4}$ and $11\frac{3}{4}$ inches, with the calibres $86\frac{1}{4}$, 162 and 216.

And farther, the propriety of considerably reducing the windage of cannon, long insisted upon by the most intelligent artillerists, is now so generally admitted, that the new long howitzers for field service, have a reduced windage of only 0,71 lines: and to place the matter beyond doubt, thousands of shots were fired with a windage of 0,53 lines. The reduction of wind-

age, therefore, in the bomb cannon, was by no means excessive. On the contrary, far from increasing the windage assigned the bomb cannon, it seems evident that a similar reduction should be applied to the ordinary gun, in order to effect a like improvement.

16. *Remarks on the danger incurred by shipping in the use of bombs, or in being exposed to those of an enemy.*

Powder enclosed in iron globes, will evidently be less exposed to accident than when contained in wooden barrels, and flannel cartridges: and all risk may be easily avoided by proper precaution. Neither are bombs any novelty afloat; as they have been used in the navy for 140 years, of the largest size and in great quantity, for the purpose of bombarding cities: why not, then, equally employ them to attack shipping?

If it be objected that the hollow shot of 19, 26 and 39, embarked in 1798, at the reiterated request of all the commandants of artillery, caused a serious accident in one of the ships at Aboukir, another at the fight of Groix, and that a vessel loaded with a supply of them was thereby blown up; it can still be urged, that although these facts are undeniable, they are still by no means sufficient ground for the disuse of hollow

shot;—for the accident at Groix arose from putting 8, 12 and 18 shells together in chests which were paraded in the most exposed parts of the vessel; the disaster at Aboukir was owing to a similar imprudence; and the destruction of the other vessel was known to have been caused by the disobedience of a workman. Now, if the ordinary charges were carried about 8 at a time, instead of singly; were permitted to accumulate around the guns; or if work of an improper kind were performed in a vessel loaded with powder, innumerable accidents must unavoidably occur; as it is, there are but too many, and yet the use of powder has not been abandoned on that account.

It may be very properly said also, that if in addition to the powder, a large quantity of shells be admitted on board, there must be an increased probability of danger. The peculiar advantage of the bomb cannon, however, is, that a small number of shells being equally efficient as a large quantity of hollow shot, a few only of the new kind of gun will be required in a vessel. Proper precaution will then be easy, and each bomb, enclosed in its case, will be carried from the magazine to the gun without the possibility of accident; the fusee will not be exposed till in the mouth of the piece, and the formidable effect

of the missile itself be exerted on the enemy alone.

Lastly, some hundred bombs well luted and secured in their magazine, will be infinitely less dangerous to a ship than some hundred barrels of powder. Transportation from the magazine to the battery can be effected without danger, by carrying them one by one in their closed cases—and there will be no more risk in transferring them to the gun, since the fusee is only uncovered when in the muzzle of the gun. And should a fusee, by any accident whatever, be ignited before placed within the gun, there will be half a minute to throw it in the sea, which could not be done with a cartridge of powder.

From the details already given, the effect of a bomb fired from another ship may be readily imagined;—and it will be difficult to become familiar with peril of this kind. Still, the improvements which are applied to offensive means will always be met by corresponding changes in the manner of constructing vessels: Tactics also, will be adapted to these changes, and the probability of receiving a shell will diminish as the fighting distance is increased. The idea of rendering ships shot-proof may be successfully brought into practice, and will be followed by an appropriate diminution of their size. And

on the whole, we may even anticipate that the average amount of destruction will be less.

17. *The disuse of heavy Ships of the line will necessarily result from adopting the horizontal projection of Bombs.*

With respect to what has already been said on this subject, I may remark: that in suggesting a system of naval *matériel* less colossal than that now in service, and which must result in the exclusion of the present heavy ships, I never had an idea of advocating the *entire* adoption of small vessels, as has been affirmed: for every one must be aware that ships of a certain size are absolutely necessary to sail well, and to use their guns in heavy weather. My object has been merely to show that with bomb cannon, a small steamer manned by few men, could place the heaviest ship in imminent peril; and has not this assumption been fully sustained by the trials at Brest? The naval commandants also, have fully confirmed this position by the conclusions given in their reports already quoted.

In the proposed scheme it was intended that the inferior class should consist of small steamers; the larger vessels to be frigates: the latter being fully able to stand the heaviest weather, and when armed with bomb cannon, might even

cope with the heaviest three-decker mounting the ordinary artillery, a circumstance worthy of consideration.

And even should ships of the line make use of bomb cannon, it is evident, that when such decisive means are employed, it will be better to divide a cost of 30 millions (francs,) in the construction of 30 frigates, than to build 10 heavy ships. For, after the evidences obtained in the trials at Brest, it would hardly be advisable to risk the loss of 800 seamen and 3 millions (francs) by a single cannon shot. Hence it may seem not so very unreasonable to have suggested the suppression of ships of the line.

The remainder of Colonel Paixhans pamphlet is occupied with remarks upon various applications of bomb cannon to the sea service; steamers, &c. These seem to contain nothing which would be useful or important to a practical seaman, and are therefore omitted in this translation: The present artillery practice of the French navy, especially in shot-shells, might undoubtedly afford much curious and interesting information. But it would be difficult, if not impracticable, perhaps, to obtain details sufficiently authentic to be relied on. It is well known, however, that two or four bomb cannon are now mounted in every ship of the line and frigate.—They seem to be much relied on by the French officers, and in the expected attack on Vera Cruz may afford some evidence of their real utility.

The following items contain some information with respect to the Marine of France, taken from authentic sources, that may not be uninteresting to professional men. The present force of this branch of the public service is given in a Navy Register published yearly by order of the Minister of Marine: which office is now filled by Vice

Admiral Ducampe de Rosamel, although ranked by two full Admirals and four Vice Admirals. The Admiralty Council consists of one Vice Admiral, three Counsellors of State, and three Rear Admirals:—of this the Minister is President *ex officio.*

The list shows—

2	Admirals.	
9	Vice Admirals.	
17	Rear Admirals.	
29	Captains of 74	1st class.
49	do.	2nd class.
24	Captains of Frigates.	
26	Captains of Corvettes	1st class.
97	do.	2nd class.
90	Lieutenants	1st class.
353	do.	2nd class.
550	Ensigns.	
151	Midshipmen	1st class.
107	do.	2nd class.

Ships of the Line.

In Commission	1 of 120
	1 of 100
	4 of 86
	2 of 80
	2 of 90
In ordinary	2 of 120
	2 of 110

	1 of 86	
	6 of 80	
Kept ready for sea	1 of 80	
Building	4 of 120	
	12 of 100	
	11 of 90	—Total 49

Frigates.

In Commission	1 of 58	
	4 of 60	
	4 of 52	
	3 of 46	
In ordinary	2 of 58	
	6 of 60	
	2 of 52	
	1 of 50	
	7 of 46	
Fitting out	1 of 50	
	1 of 52	
	3 of 46	
Building	9 of 60	
	10 of 50	
	5 of 40	
Rebuilding	1 of 52	—Total 60

Corvettes.

In Commission	11
In ordinary	13
Building	1

There are 31 steamers, and those in service are mostly in the Mediterranean; they mount from 5 to 6 guns, and are commanded by Lieutenants, excepting one, on board of which there is a Captain of Corvette 2nd class. The following list contains all the information respecting them which is officially given.

Name.	*Engine Horse Power.*	*Guns.*	
Lavoisiér,	220	6	Building.
Véloce,	220	6	do.
Caméléon,	220	6	do.
Gassendi,	220	6	do.
Nageur,	160	5	In ordinary.
Sphinx,	160	5	In commission.
Ardent,	160	5	In ordinary.
Crocodile,	160	5	In commission.
Fulton,	160	5	do.
Chimère,	160	5	do.
Styx,	160	5	do.
Météore,	160	5	do.
Vautour,	160	5	do.
Phare,	160	5	do.
Achéron,	160	5	do.
Papin,	160	5	do.
Cerbère,	160	5	do.
Tartare,	160	5	do.
Etna,	160	5	do.

Brandon,	160	5	Building.
Cocyte,	160	5	In commission.
Phaèton,	160	5	Fitting out.
Tounerre,	160	5	Building.
Euphrate,	160	5	do.
Ramier,	150	5	In commission.
Castor,	120	5	do.
Brasier,	100	5	do.
Flambeau,	100	5	Building.
Coursier,	60	3	In commission.
Erèbe,	60	4	Building.
Africain,	40	4	In commission.

At the conclusion of the navy list is given a synopsis of the various ordinances, laws, &c., which have at various times been issued for the organization and government of the navy.

The best remarks on these are contained in the following extract from the preface to the "Ordonnance du Roi," issued by Charles X. in 1827, which constituted the code by which the French navy was principally conducted until the late revolution.

"To the Bourbons France is clearly indebted for her navy: From Henry IV., while occupied with a domestic war, it received the first outline; —increased rapidly under Louis XIII., who so ably seconded the efforts of Richelieu; and attained its zenith of glory in the reign of Louis XIV.

In recording the facts connected with these events, sufficient attention has not been given to causes:—Yet it cannot be doubted that the navy owed its success under Louis the Great, to the untiring perseverance of his administration in keeping pace with the progress of society and the advancement of science, at home and abroad. From 1647 to 1676 more than 150 edicts, declarations, ordinances and regulations were issued concerning *the rank, duties and emoluments of officers; the enrolment of seamen; the distribution of a ship's company; their quarters, pay and rations; the construction, armament and equipment of ships; service afloat; preservation and government of arsenals; naval jurisprudence; hospitals; protection of the coast, &c.* Thus through a period of 30 years were gradually collected the materials for the Naval Ordinance of 1689, in the same manner as a large number of special ordinances had laid the foundation of that of 1681, respecting the commercial marine. And indeed such must always be the course of proper legislation for the sea service.

"For seventy-six years the navy of France was guided by the ordinance of 1689.

"In 1765 Louis XV. *thought it advisable to make several changes in this code, and to add certain new regulations thereto, with the view*

of rendering permanent whatever long experience had proven to be most advantageous to the service.

"During the continuance of this ordinance, and of the war from 1778 to '83, which was highly creditable to the navy; the necessity began to be felt of some additional regulations extending, limiting, or defining certain powers exercised at sea; and in 1786 there were published 13 ordinances and 11 decrees relating to service in ships sailing singly or in fleets.

"Of all the epochs in which the navy experienced the effects of new legislation, none present more change, uncertainty and inconsistency than that following the memorable events of 1789. The entire structure of the French navy was levelled, and every thing but valour, engulphed in the vortex of the revolution; after a struggle unexampled in the annals of history, the restoration gave protection to the navy, and again opened for it the path to security and to glory."

In farther comment on the condition of naval affairs until 1815, the writer insists that—"the navy must move onward with the time: no system of regulation can possibly be devised that will not require alteration and amendment at some future period. The arts most intimately connected with the service are advancing daily;

—the incalculable power that man wields by the agency of steam gives an impulse to science that seems to have no limits; from this career, that of a navy cannot be separated.

"Under such circumstances the king has been pleased to issue an ordinance better adapted to the existing state of affairs, and embodying every species of improvement that has been introduced in the navies of Europe for the last 40 years."

After the memorable events of July, 1830, the navy did not escape the notice of the "citizen king:" Sixty-four ordinances, decrees, &c., were issued at different times respecting the Marine of France. Among these the most important are, that of August 13, 1830, creating the rank of Admiral;*—of November 1, 1830, establishing a Naval School;—of March 1, 1831, reorganizing the Navy, and the ordinance of June 14, 1837, authorizing a School of Artillery at Brest and Toulon.

The marked attention that is now bestowed by the government of France on its naval power, and the manifest and important improvement attendant thereon, both in theory and practice, seems to have attracted notice in England, as

* This grade was laid aside by Louis XIII. in 1627, restored by Louis XIV. in 1669, and again suppressed by the National Assembly in 1791. The dignity of Admiral was afterwards conferred on the Duke d'Angoulême in 1814.

well as elsewhere. Several well written articles on the subject have lately been inserted in the columns of the United Service Journal, and no detail, however minute, seems to have escaped the scrutiny of the writer: His conclusions fully sustain the opinion generally entertained of the increasing excellence of the navy of France. There is nothing novel, however, in all this. From the time of Louis XIV., the greatest importance has been attached to the marine, and history has faithfully recorded the enormous expenditure incurred for the purpose of giving efficiency to this department, and the signal misfortunes that have in the end blighted the zealous and indefatigable efforts of the French Admirals. The *tricolour* will hardly lead to a better fortune, and has yet to win many a laurel before it can aspire to comparison even with the latter days of the *drapeau blanc*. With every present advantage France is not in any degree as able to cope with her maritime neighbour as she was 160 years ago. The fleets of Louis XIV. and XV., though ultimately almost annihilated, were often in condition to dispute the supremacy of the seas with England and Holland; and even after the catastrophe of La Hogue were able with renewed strength to check and harass the English squadrons in their operations abroad.

The annals of those days record no such triumphs as those of Nelson at the Nile and Trafalgar.

The peculiar advantages of the French navy consist in the superior excellence of its *matériel*, —ships built in the most enduring manner after models of surpassing beauty and speed,—artillery of the best quality and finish, and in general the aid of every advantage that profound science and talent can contribute. England, on the other hand, with a *personnel* perfectly familiarized by long habit and practice to a life on the ocean, finds it necessary to give far less attention to the improvement of her *matériel*, and is often content with borrowing from her neighbour.*

The latter, with every exertion and expense that the genius and resources of a mighty nation can

* "Mais cet art (the use of bombs in ketches), porté bientôt chez les autres nations . . . . . fut plus d'une fois redoubtable à la France *où il fut inventé*.

"VOLTAIRE. Siècle de Louis XIV."

"L'art de bombarder les villes maritimes avec des vaisseaux *retomba alors sur ses inventeurs*. Se n'est pas que la machine infernale avec laquelle les Anglais voulurent brûler Saint-Malo, et qui échoua sans faire d'effet, *dut son origine à l'industrie des Français*, &c. Il y avait déjá longtemps qu'on ávait hasardé de pareilles machines en Europe. C'était l'art de faire partir les bombes aussi juste d'une assiette mouvante que d'un terrain solide, que les Français avaient inventé; et ce fut par cet art que Dieppe, le Havre-de-Grâce, Saint-Malo, Dunkerque et Calais furent bombardés par les flottes Anglaises.

"VOLTAIRE."

command, has never been able to supply her fleets with such seamen as Great Britain boasts of:—and until this disadvantage be surmounted, the tricolour may never hope to win one ray from the halo that has glittered on the brow of England since the disaster of La Hogue.

The reader has already been informed that the foregoing translation, with the prefatory and concluding remarks, were written some time ago: After they were put to press I learned from a naval friend that the large work of Colonel Paixhans had been reviewed in an American periodical by the late Lieutenant Mackay. This gifted and excellent officer met an untimely fate in our favourite Hornet, which put to sea from Tampico in 1829, during a Norther, and has never been heard of since that time. It was to me a subject for regret that I had not before known of the existence of this notice by Mr. Mackay, as it would have enabled me to substitute his remarks for the few hasty lines of my own that now precede this translation. As it is I have availed myself of the opportunity to give the extracts that follow. It will be observed that Mr. Mackay seems to have had no knowledge of the experiments now submitted, but treats merely of the principal works of Paixhans, in which the plan itself was first proposed.

Referring to the favourable opinion of Napoleon, he says:

"The sanction of such a name would be in

itself sufficient to secure our attention to the subject, however extravagant it might at first appear; we however hope to show, that the merits of this work claim, in a particular manner, the attention of military and naval men, both as it regards the modifications it is liable to produce in their respective professions, particularly the latter, as well as the more important subject of national defence." * * * * *

"With regard to firing bombs, and hollow *spherical* projectiles of any kind horizontally, we conceive there are but two conditions necessary, namely,—momentum proportioned to their size, and that the projectiles should be symmetrical. *Bombs* have hitherto been practically considered only in one point of view; they have invariably been fired with great angles of elevation, producing effects in many instances almost equally terrible, by their momentum in a vertical direction, as by their subsequent explosion; but however efficacious this mode of firing, in the attack of fortified places, where the situations fired from, and at, never change, and the range being once obtained, every shell is thrown with fatal accuracy, or falling any where within the place, does pretty nearly equal damage;—yet in firing at ships, the case is very different. Where the two objects, in themselves small, are every moment changing their relative positions, often moving with great rapidity, it is next to impossible that shells should take effect one time in a million, setting aside the impossibility of preserving for a single moment the desired angle of elevation. Among clusters of ships in port, or in particular situations, the ordinary bomb would

prove a most *destructive* instrument—but if bombs can be fired horizontally, of which we entertain not the slightest doubt, then, to the power of the common cannon ball, we add that of a shell also." * * * * *

"When carronades were first introduced, their inventor, General Melville, suggested that they could not only fire solid shot, but might also be used for throwing carcases and *cored shot*; that is, in fact, the very shot now proposed by Mr. P. In consequence of this suggestion, some experiments were made in the same year, 1779, in presence of Sir Adolphus Oughton, General Melville, and a number of engineer officers, at Carron, where the guns were cast. The result of these was such, as to determine at once the practicability, and the great and powerful effects produced by their explosions wherever they penetrated: they were recommended both for the land and sea service. In 1780, a series of experiments was made at Fort Languard, by order of Lord Townsend: they were fired alternately, with solid and hollow shot, at point blank ranges, and up to elevations of $2\frac{1}{2}^{\circ}$ and 3°. The hollow shot gave the longest distances to the first graze; and, although the extreme range was rather less than that of the solid ball, they were nevertheless highly satisfactory; and the guns were considered very superior to the eight inch howitzer. The objections made to the employment of such heavy and unmanageable shot, on board ship, it was thought would be removed, by their weight being thus reduced, from sixty-eight, (which was the calibre of the first carronades,) to about thirty-two pounds. The irresistible effect of such

shot, in blowing up, splitting, and tearing to pieces, in a sea fight, was strenuously urged. The gun used on this occasion, was of eight inch calibre, weighing twenty-nine hundred weight, being rather more than the average of the forty-two pound carronade employed in our service, and was fired with charges varying from four to six pounds of powder; its length of bore being four feet, nearly a diameter shorter than that of our forty-two pound carronade.

"Some other experiments were made with the same gun, with different weights of shot, before the Duke of Richmond and General Melville, which we believe were equally efficient—these took place in the following year, 1781. In 1813, a small howitzer was used on the poop of one of our ships on Lake Ontario. But it is obvious that a gun intended to be fixed in a bed or carriage on shore, and fired with certain degrees of elevation, could be but of little service on the deck of a ship in continual motion, being fired in the usual way —parabolically. And in the unremitting labours of a short but harassing campaign, there was no time to give attention to subjects of this kind, and any plan not giving immediate practical results, would of course be abandoned. We merely mention this fact, to show that the idea has been thought practicable on this side of the Atlantic." * * * * *

"But by far the most important part of this book, indeed, of the work, we may say, is the plan of combining this new armament with steam navigation; and such is its importance to the United States, that it cannot be too strongly urged on the attention of government. The two great

naval powers of Europe, are so deeply impressed with a conviction of the prominent part which this new element will take in future wars, the different aspect which these will assume, and the different results which may confidently be looked for in maritime affairs, that various experiments are actually in operation, to determine—not the practicability, for that is considered beyond a doubt,—but how far this shall supersede the present ordinary means of defence, and to what extent it shall be introduced, at present, in the cruising marine, as well as in coast defence. These are not the wild schemes of projectors, but the serious and well digested plans of such as have long regarded it as intended to operate changes, equally great in war, as in navigation and industry:—

"In 1816," says Mr. P., 'an enlightened statesman did not hesitate to say publicly at the Institute, 'the most important result from the invention of steamboats, will be the changes which will take place in maritime wars, and the power of nations;—it is certainly probable, (he added,) that we have, in this invention, one of those experiments, which change the face of the world.' " p. 288.

"The advantages of steam navigation are known to none better than to ourselves. On no nation has it conferred greater benefits; and no where has the art been carried to greater perfection. In point of strength, elegance, convenience, and swiftness, we yield to none. Indeed, in the latter very desirable quality, we are disposed to think we have exceeded all others; certainly, no greater degree of velocity has been

obtained any where; and exertions are still making with a view to improvements in all these particulars; and though we are aware, that some few of our steamers may approximate to a limit beyond which any increase of speed may be physically impossible; yet we are far from believing that this *maximum* velocity has been attained. The transition from an ordinary steamer, to one adapted to the purposes of war, is by no means great; and the situation of our country as it regards geographical peculiarities, as well as physical resources, would lead us to anticipate advantages, not less great, from its employment in war, than we have already derived from its application to ordinary navigation and the arts. A flotilla, *à la Paixhans*, the officers and crews of which should be completely drilled in the management of the *motive* power, as well as to the use of the new artillery, would present a formidable, not to say irresistible force. We are aware, that the bare idea of such a possibility, as that of rendering null, the splendid preparations we have of late years been making for naval war, of forcing the towering structure, with her three or four tiers of cannon, to yield to the smoky and unseemly steamer, will be violently to overthrow all our preconceived notions of sea fights. The aspirants for the fame of Duncan, Howe and Nelson, will reluctantly yield their assent to a system, which to appearance promises so little—offers so few opportunities for fame and honours.—They cannot consent to relinquish their splendid visions of glory, for what they consider an humble, and petty warfare of steamboats;—but if the system of steam defence ob-

tains in Europe, it *must be* adopted here:—if we will not lead, we must at least follow. Admitting for a moment, that the system should produce none of the effects contemplated by our author and others, and that the fleets of the world should continue to carry on their operations as heretofore,—the defence of our coast by steam, is not a whit the less important, or feasible. The great difficulty which all nations find in manning their fleets, and which has in fact been already recognised by that department of the government whose duty it is to provide for such contingencies, will be in some measure relieved by this species of force.—An incalculable advantage of steam warfare, is the comparatively slight degree of instruction necessary to qualify for efficient service on board such vessels. Under officers duly qualified, and selected with a view to these duties, the exercise of the guns, whether bomb cannon or the usual ship guns, may be learnt in a short time: the men need not necessarily be seamen, but may be drawn from other sources. For service of this kind, we believe there are other classes of our population much more valuable than 'seamen,' (we now use the word in its restricted sense.) The crews of the steamers may be recruited from landsmen, as well as from that hardy and active race of men employed in our inland water trade, who, though unwilling to risk the 'dangers of the seas,' would cheerfully serve in a flotilla of this kind. It would be in perfect accordance with their previous habits; and their hardihood, intelligence, and local knowledge, peculiarly qualify them for the duties of steamers. Thus, at the

commencement of a war, we should have on the spot most requiring immediate defence, a numerous class of persons, the best qualified for the purpose.—In case of sudden invasion, the *whole* population of the coast, may be considered competent to its defence, in either land or steam service; whereas the duties of *seamen*, as distinguished from the other classes of men who fill up the ranks of the navy, are various and complicated, and though not difficult of attainment, yet require some years of labour and practice, ere a man can dub himself '*sailor*.'—The tactics of steamboats, though requiring both skill and practice, will be infinitely less difficult and complicated than the system of tactics for fleets, which depend for the success of their movements, on an element proverbial for instability; while the steam tactician has only to conceive his plan, and he is certain of its execution; he has only to determine on his mode of operation, and he is sure of effecting it: to the steam navigator no point of the compass is interdicted; he has neither head winds nor calms—instead of being at the mercy of the motive power, he wields it at will." * * * * *

"A steamer, with a bomb cannon, must take infinitely less to construct, and maintain, than a sloop, with a crew of one hundred and sixty men; yet we imagine there can be no comparison in point of efficacy. What chance would one of the largest sloops of war stand with an opponent of this description? Of the probable influence of such a system, if but *partially* successful, there can be but one opinion. The attack and defence of coasts, will be an entirely

different matter to what it has hitherto been; blockades will be extremely difficult, if not impossible; and so peculiarly is this mode of defence adapted to the United States, that an energetic and judicious management of it will, if we do not entirely mistake results, completely insure the integrity of our soil. We may venture to assert, that no ship of the present armament, would risk being caught in our water by a steamboat *a la Paixhans;* nor would a single ship of the line be able to blockade the Delaware, and lay a town under contribution. What would be the fate of blockading squadrons similar to those which lay undisturbed in the Chesapeake, the Delaware, the Sound, and other places, during the last war, if they should be attacked by a steam flotilla, even of the ordinary kind? They could not maintain their positions for a single hour. Should the enemy bring a similar force, this would be a still stronger reason for its adoption on our part; and the advantages we should possess over any nation crossing the ocean for the purpose of attack, are too obvious to need exemplification." * * * * *

Lieutenant Mackay's opinion is summed up by himself in the following words:—

"We have, hitherto, with some exceptions scarcely worth mentioning, fully coincided with the plans of Mr. P., as far as relates to the practicability of them, as well as the results likely to ensue, from their partial or entire adoption, whether we use the present calibre, or those of forty-eight, which we have already described; but we are by no means so clear with regard to

the heavy calibres of *one hundred and fifty, and two hundred.* Without any reference to the expediency of such tremendous agents, we consider them as unmanageable on ship board; for, though not as heavy as their nominal calibre, being hollow, and reduced to *one hundred and ten,* and *one hundred and fifty pounds,* respectively, they are still obviously too heavy to be handled in the usual way." * * * * *

The carriage proposed by Paixhans he also objects to, and there is very little doubt that in this respect, as well as in his views generally of the shot-shell scheme, the officers of the navy will, with few exceptions, concur. In forming his opinion, Mr. Mackay had no data before him but the reasoning which Paixhans had presented from the practicability of a mere project. And yet how well is he sustained in this opinion by the series of experiments made subsequently by order of the French government.